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GEOGRAPHIC DISTRIBUTION OF CANCER IN ILLINOIS

by

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## I. Introduction

This project is the initial phase of a three year study to map and analyze the geographic distribution of cancer mortality in Illinois, with special attention to associations between cancer mortality rates and ambient exposures to industrial carcinogen emissions. Funding for the subsequent phases of the project is currently pending.

The main focus of the project is to examine the variation of certain site specific cancer mortality rates and exposure levels to industrial carcinogens. In a typical study, the area around a major industrial source of carcinogens is mapped into two or three tracts based on exposure to the carcinogen(s). It is planned in future studies to perform the mapping, using ground level monitoring and calculations with dispersion models and emissions data. For the two areas included in the initial phase of the project exposure tracts were mapped on the basis of proximity to industrial source and E.P.A. ground level monitoring of criteria pollutants.

For each area studied, age adjusted mortality rates for cancers of certain sites were (will be) computed using death certificates from the period 1969-1977. The Mantel-Haenszel modification of the chi square was (will be) used to test the significance of the difference of the mortality rates.

Industrial sources were (will be) selected on the basis of type and quantity of carcinogen emitted, availability of emission information, and size of population exposed. Major sources considered were: steel mills with coke ovens, petroleum refineries, metal smelters, incinerators, and chemical plants. Major carcinogens considered included polycyclic and aromatic hydrocarbons (PAH), benzene, arsenic, cadmium, vinyl chloride. The main criterion for choice of site is the ability to detect the predicted number of excess cancers.

A major aim of the preliminary project was to develop methodology for the remainder of the project. Particular attention was paid to the problems of site selection and sample size determination. Two full studies were performed during the preliminary project, and their results are presented in this report. These preliminary studies were limited by the fact that tracts were drawn on the basis of distance from source, and ground level readings on criteria pollutants. They cannot be expected to reflect ambient concentrations with the same degree of accuracy as if dispersion models had been available.

Because many teratogenic substances have also been shown to be carcinogenic in animals, and because some epidemiologic evidence has associated exposure to carcinogens with excess rates of birth defects, we have included preliminary investigations on congenital malformation in this project. The investigations on congenital malformations parallel those on cancer. Because of the much shorter latent period for congenital malformations, it is possible that results from this part of the study will be less confounded by such factors as geographic mobility than the study on cancer mortality.

A second aim of the project is to examine associations between cancer mortality rates and possible etiological factors. Pearson correlation coefficients were computed between selected cancer morality rates by county, and possible etiologic factors including: concentration of certain industries, sunlight, population density, and mean income. Additionally, congenital malformation rates were included in this study. Continuation of these analyses with more recent data is planned for the remainder of the project.

A third aim of the study was to update the Illinois cancer map. County rates for cancers of a number of sites were computed for the period 1970-1977. Those were compared to the rates for the period 1950-1969 which have already been published.

## II. Background

Striking geographic variations in the distribution of cancer incidence and mortality have been demonstrated by several studies.<sup>1,2,3</sup> These geographic differences in cancer risk may be quite localized, extending to the county level or lower, and often are of considerable magnitude at this level.<sup>2</sup> Comparisons between the 10% of counties with the highest rates and the 10% with the lowest rates often give ratios exceeding three for specific cancer types.<sup>4</sup> Such differences are found in Illinois with three counties in the highest decile for total cancer rate for females, compared with much lower rates in much of the state. Large differences in cancer risk were also found in Illinois for several specific cancer types for both sexes.

The urban-rural factor is strongly associated with differences in cancer rates.<sup>5</sup> For most cancer types, the ratio of the mortality rate in urban counties to that in rural counties is greater than one, and in many cases is above two. The urban-rural differences cannot be accounted for only by differences in smoking.<sup>6,7</sup> Several factors may be considered which could account for both the general geographic differences and these urban-rural differences in cancer risk, including exposure to environmental carcinogens in the workplace and/or in the community from air and/or water pollution. Further analyses of the geographic distribution of cancer

by county have shown associations between elevated cancer mortality rates and the presence of certain industries including paper manufacturing, chemical, petroleum, metal refining, and transportation.<sup>8,11</sup> Cancer sites with elevated mortality rates included lung, nasopharynx, stomach, bladder, liver, rectum, testes, and skin. However, these county by county studies cannot determine whether these elevated rates are due to occupational or community exposure to carcinogens.

Air pollutant level has been found to be related to lung cancer risk by several studies.<sup>12,16</sup> These increased risks have been related to exposure to benzo(a)pyrene (BaP), polycyclic and aromatic hydrocarbons (PAH), and heavy metals. These increased risks have been found in both neighborhood by neighborhood studies and regression studies on a state basis. In some cases where cigarette smoking levels were controlled, the strong association between lung cancer mortality and smoking remained. In none of these studies was occupation controlled or considered.

Many workers in the United States are at high risk for cancer due to their occupational exposures. A recent report estimated that up to 40% of all cancers occurring in the United States are related to occupational exposures.<sup>17</sup> Many of the industries associated with increased cancer rates due to occupational exposure also expose community residents to carcinogens emitted into the air and water. U.S. Environmental Protection Agency (EPA) estimates indicate that the community exposures may be substantial in many cases.

Several Illinois counties have highly elevated rates for specific types of cancer.<sup>2</sup> Strong correlations between the prevalence of industry and mortality rates for certain cancer types have been found in Illinois.<sup>4</sup>

Especially notable was the correlation of the metal industry concentration with male lung cancer mortality. Substantial environmental exposure to BaP, benzene, cadmium, and arsenic occurs in many areas of Illinois. Much of the exposure occurs in the Illinois counties with higher cancer rates.<sup>4</sup>

Another possible effect of exposure to industrial pollutants is an increased risk of congenital malformations. Some occupational exposures have been linked to increased risk of congenital malformations<sup>18,19</sup>, and on the basis of animal studies many more carcinogens have demonstrated the potential to increase this risk. Very little is known about the effects of environmental pollution from industrial sources on the community rates of congenital malformations. Potentially this effect could be substantial and should be manifest without the long latency period required for cancer.

### III. Rationale

The studies described above suggest that carcinogens emitted from major industrial sources contribute to the excess regional cancer mortality. However, because of inherent limitations they have not established a causal relation between the cancer mortality excess and emissions of industrial carcinogens, nor have they been able to establish the magnitude of the hypothesized effect. Limitations and problems common to many of these studies include:

- (a) No discrimination is made between residents of a county living in close proximity to an industrial source, and residents in the same county living far away, and likewise no consideration is taken of persons living near the source in adjacent counties.

(b) No quantitative determinations of exposure to carcinogens are made.

(c) No attempt is made to discriminate between the effects of community exposure, and possible confounding factors such as occupational exposure and smoking.

This study was designed to contribute to making a more precise determination of the relation between residential proximity to major industrial carcinogens sources, airborne levels of selected major carcinogens, and regional cancer mortality rates by using emissions and monitoring data from Illinois. It was designed as a preliminary study which would develop methodology, and for overcoming some of the limitations of the studies described above, as well as test the feasibility of a more extensive study, and produce initial results.

#### IV. Report on Accomplishments to Date

##### A. Epidemiological Study on Cancer Mortality

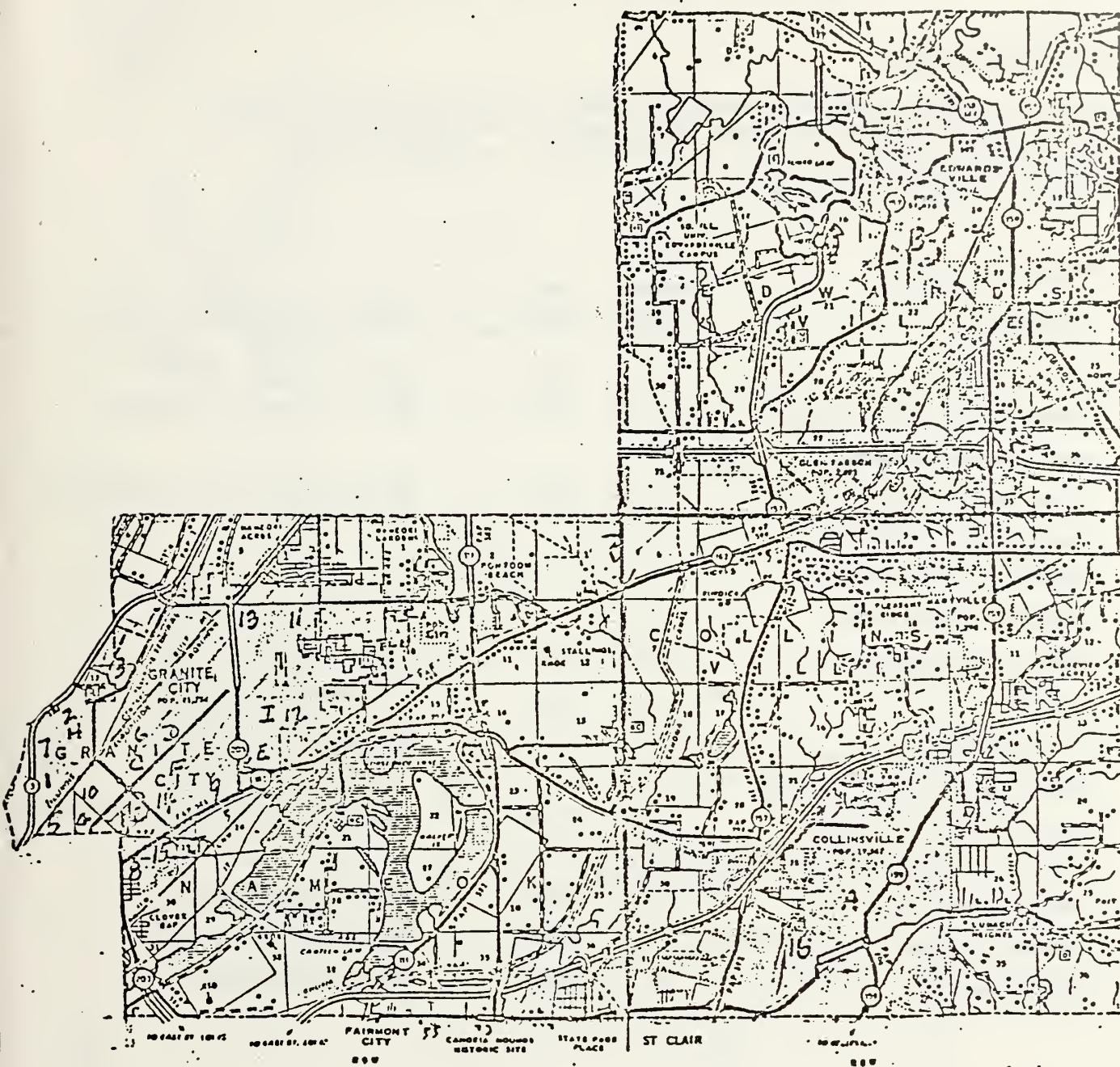
###### i. Site Selection

Three sites in the vicinity of major carcinogen sources have been selected as the first three study areas. The sites were selected and divided into exposure tracts on the basis of emissions data on sources<sup>20</sup> and ground level monitoring data<sup>21</sup>, as the dispersion model program was not yet available. The sites are: a. a region in the Granite City area in the vicinity of a major steel mill and coke plant; b. a region in the Sauget area in the vicinity of a major chemical plant, and a smelter; c. a region in southern Cook County in the vicinity of several major steel plants, foundries, and chemical plants. Figures I and II, and Tables I to III contain relevant data on sites a and b.

Additionally, as part of the site selection procedure, calculations were performed to estimate the number of excess cancers expected from exposure to carcinogens from certain industrial sources. Such calculations are necessary in order to maximize the chances of finding excess cancers, and to insure that the study has a reasonable chance of succeeding.

FIGURE I

ANNOTATED MAP OF MADISON COUNTY, ILLINOIS, SHOWING EXPOSURE TRACTS FOR SITE ONE



SEE LEGEND ON ACCOMPANYING PAGE

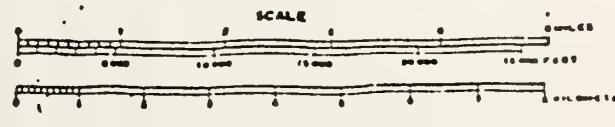
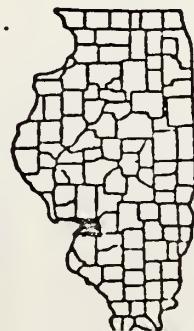
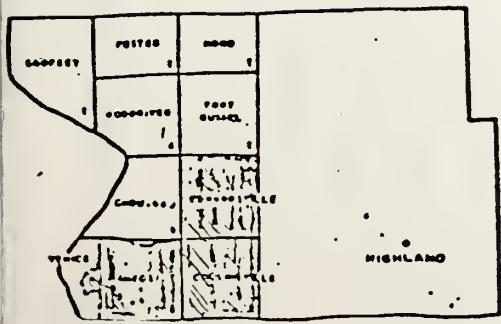


FIGURE 1 (cont.'d)

LEGEND FOR MADISON COUNTY

Inserts on map indicate location of county within the state of Illinois, and location of township tracts within the county. The high exposure area is Nameoki township, middle exposure is Collinsville township and low exposure is Edwardsville township.

MADISON COUNTY INDUSTRIES

CITY	INDUSTRY	NUMBER ON MAP	SIC CODE	TYPE OF INDUSTRY
Granite City	A. O. Smith	1	3714	Motor vehicle parts
	Archer Daniels Midland	2	2041	Flour and mill products
	Bulk Services Corp.	3		
	Granite City Steel	4	3312	Blast furnace and Steel mill
	Granite City WWTP	5		
	Hoeffken Bros. Inc.	6		
	International Mill	7		
	Nesco Steel Barrel	8	3491	Metal barrels
	Nestle	9	2099	Food preparations
	N L Industry	10	3341	Secondary nonferrous
	Reeves Concrete Products	11		
	Reilly Tar & Chemicals'	12	2814	Chemical and allied products
	Tri-City Reclamation District	13		
	Jennison-Wright	14	2491	Wood preserving
Collinsville	American Steel Foundry	15	3493	Steel springs
	McLair Asphalt	16	2951	Paving mixtures

## MADISON COUNTY MONITORING STATIONS

TABLE I

1977  
AMBIENT METAL  
CONCENTRATION  
( $\mu\text{g}/\text{m}^3$ )<sup>a</sup>

STATION (LETTER ON MAP)	ADDRESS	TOTAL SUSPENDED PARTICULATES ( $\mu\text{g}/\text{m}^3$ )						ANNUAL MEAN ( $\mu\text{g}/\text{m}^3$ )						ANNUAL STATISTICS		
		1971	1972	1973	1974	1975	1976	1977	ARITH. MEAN	STD.GEO. DEVIATION	AS					
Collinsville (A)	115 A W. Main	85	67	60	66	68	76	75	-	-	-	.002				
Edwardsville (B)	Main & Purcell	78	69	54	53	54	58	56	-	-	-	.002				
Granite City (C)	2000 Edison	179	163	143	*	96	114	108	.012	2.23	.013					
Granite City (D)	23rd & Madison	127	124	110	93	105	123	112	.023	2.58	.010					
Granite City (E)	3201 E. 23rd	123	89	88	86	68	83	81	-	-	-	.006				
Granite City (F)	2001 E. 20th	174	205	202	158	158	205	186	-	-	-	.009				
Granite City (G)	15th & Madison	174	200	161	*	138	155	131	-	-	-	.013				
Granite City (H)	Roosevelt & Rock Rd	-	116	82	86	97	111	107	-	-	-	.010				
Granite City (I)	2040 Johnson Ave.	-	-	-	-	*	84	-	-	-	-	.006				
Granite City (J)	Norfolk & Western	-	-	-	*	139	133	-	-	-	-	.007				
Granite City (K)	24th & Nameoki	-	-	-	-	-	112	-	-	-	-	.008				

<sup>a</sup> Source Reference 22

\* Data not available

FIGURE II. ANNOTATED MAP OF ST. CLAIR COUNTY, ILLINOIS, SHOWING EXPOSURE TRACTS FOR SITE TWO

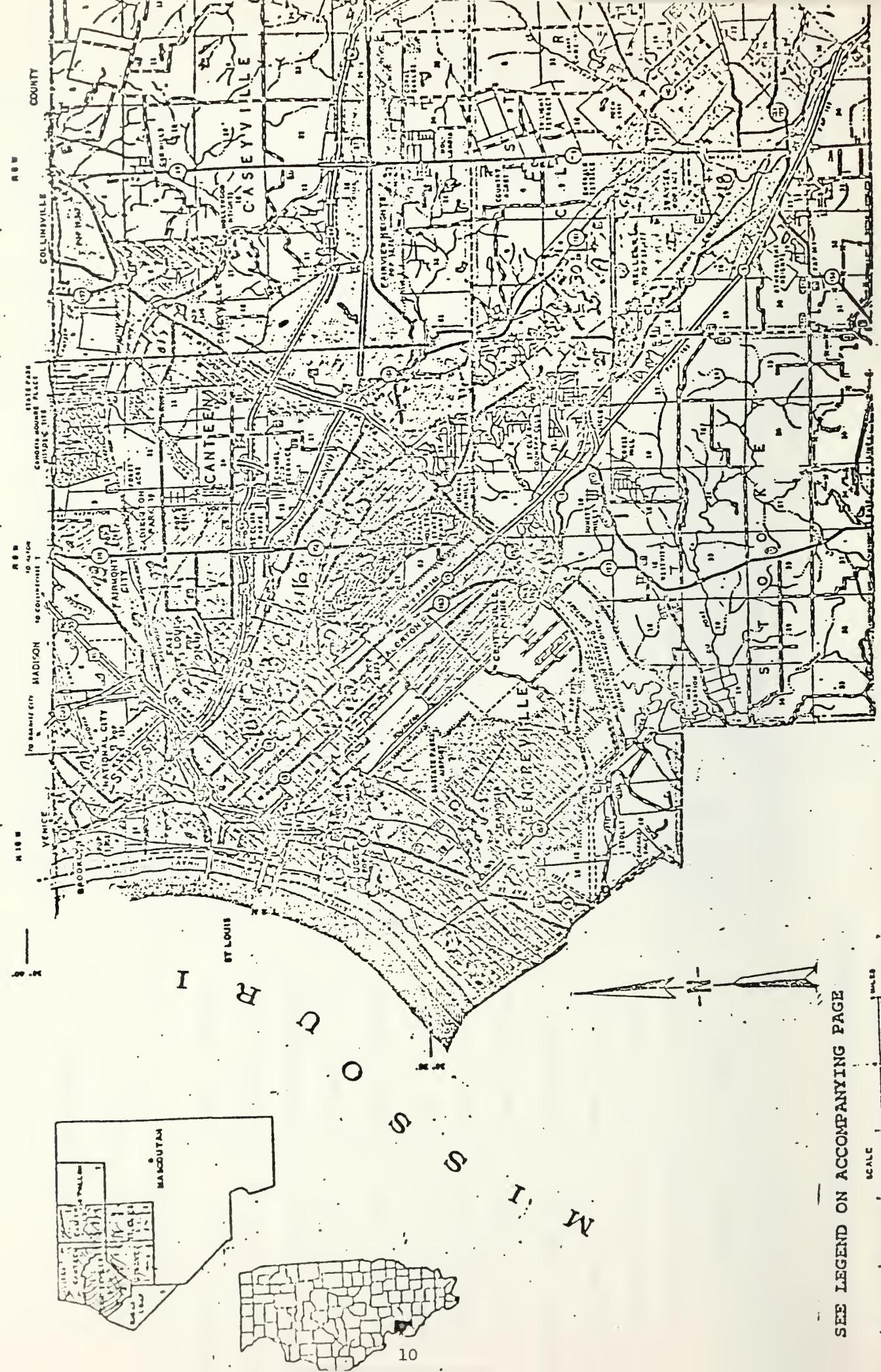


FIGURE II (cont.'d)LEGEND FOR MAP OF ST. CLAIR COUNTY

Inserts on map indicate location of county within the state of Illinois, and location of township tracts within county. The high exposure area includes Centreville and Canteen townships; the low exposure area includes Stookey, St. Clair and Caseyville townships.

## ST. CLAIR COUNTY INDUSTRIES

CITY	INDUSTRY	NUMBER ON MAP	SIC CODE	TYPE OF INDUSTRY
Gaget	Amay Zinc	1	3341	Secondary nonferrous metals
	Cerro Copper & Brass	2		
	Midwest Rubber	3	3069	Fabricated rubber products
	Mobil Oil	4		
	Monsanto	5	2818	Industrial organic chemicals
	Sterling Steel Cast	6	3312	Blast furnace, steel mills
	Edwin Cooper	7	2911	Petroleum refining
	Cahokia Power Plant	8	4911	Electric companies
E. St. Louis	Allied Mills	9		
	E. St. Louis Cast	10	3321	Gray iron foundry
	H. H. Hall	11	3271	Concrete Blocks
	Hunter Packing	12	2011	Meat packing
	Obear Nestor Glass	13	3221	Glass containers
	Pfizer	14	2812	Alkalies & Chlorine
	Prestressed Slabs	15		
	St. Louis Grain Elevator	16		
Fairmont	Allied Chemicals	17	2833	Medicinals and botanicals
	E. St. Louis Works	18	2833	Medicinals and botanicals
	Swift Chemical	19	2871	Fertilizers
Caseyville	H. H. Hall	20	1611	Road Construction
National City	Swift Fresh Meat	21	2031	Canned/cured sea food
	U. S. Steel (Agri-Chemical)	22		
Cahokia	Phillips Pipeline	23	2911	Petroleum refining
	Reese Construction	24	2951	Paints and allied products
Belleville	High School	25		
	Carling Brewing	26	2082	Malt liquors
	Excelsior Foundry	27		
	Peerless Enamel	28	3731	Household cooking equipment
	Richland Foundry	29	3321	Gray iron foundry
	Roesch Enamel	30	3461	Metal stampings
Swansea	Hoeffman Bros.	31	3272	Concrete products

## ST. CLAIR COUNTY MONITORING STATIONS

TABLE II

STATION (LETTER ON MAP)	ADDRESS	TOTAL SUSPENDED PARTICULATES ( $\mu\text{g}/\text{m}^3$ )						SULFUR DIOXIDE (PARTS PER MILLION)				AMOUNT STATISTICS AS
		1971	1972	1973	1974	1975	1976	1977	ARITH. MEAN	STD.	GEO. MEAN	
Belleville (A)	101 S. Illinois Business Rt. 40	84	81	63	73	63	77	-	-	-	.002	
Cahokia State Park (B)		124	108	101	111	103	113	83	.014	2.18	.004	
East St. Louis (C)	7 Collinsville Ave.	105	110	87	89	80	90	.018	2.45	.008		

a Source Reference 22

TABLE III. DEMOGRAPHIC DATA ON TEST SITES

Site A Granite City - Madison County

Exposure Level	Total Population	% Black	% Foreign Born	% Spanish Speaking	Median School Years	% High School Graduates	Median Family Income in Dollars
High	67,482	6.9	2.2	0.9	10.5	40.8	9,992
Medium	26,507	1.1	2.5	1.9	1.9	50.3	10,865
Low	18,166	4.3	1.6	1.2	1.2	57.5	10,897

Site B Sauget - St. Clair County

High  
(Excluding Tracts  
with Greater than  
74% Black)

Medium	68,595	8.0	1.4	2.1	10.4	36.8	13,947
Low	97,511	0.4	1.4	1.5	11.7	52.0	11,144

Source: Reference 32

In Tables IV and V we present the results of these calculations for areas in the vicinity of two Illinois steel mills with coke plants. The dose-response curves were estimated from three different epidemiological studies. In two of the studies the relationship was based on exposure to BaP alone, while in the third it was based on exposure to BaP and As. Exposure levels were based on ground level monitoring<sup>21</sup>, population data are from the U.S. EPA,<sup>23</sup> and the conversion factor between BaP and total suspended particulates was estimated from EPA data<sup>23</sup>. The tables show that the predicted excess cancer deaths are well within a range that should be readily detectable in epidemiological studies. They also show that the predicted excesses are relatively similar for all three extrapolation procedures, varying only within a factor of two.

Preliminary calculations have also been performed for other sites, and carcinogens. Because of the wide variations in predicted excess cancers between extrapolation techniques, we have not published these results, but are still investigating the calculations.

Another calculation was performed to estimate the detectability of various percent increases in cancer mortality for tracts of various sized (TABLE VI). The increase figures indicated by an asterisk are more than twice the standard deviation of the background cancer deaths (assuming the measured number is sampled from a Poisson distribution). Such excesses differ significantly from the background with  $P < .05$  and therefore are likely to be detected. The results indicate that for population of the order of 100,000 significant differences between tracts are likely to be detected for percent excesses of 30% or more for a range of cancer types.

TABLE IV

PREDICTED EXCESS LUNG CANCERS DUE TO EXPOSURE TO BENZO(A)PYRENE FROM AND ARSENIC FROM COKE PLANT IN GRANITE CITY

DISTANCE FROM COKE OVEN (KM)	MALE POPULATION WITHIN GIVEN DISTANCE	EXPECTED LUNG CANCERS (10 YRS) WITHIN GIVEN DISTANCE	EXCESS LUNG CANCERS (10 years) WITHIN GIVEN DISTANCE PREDICTED BY GIVEN MODEL <sup>a</sup>		
			STOCKS	CARNOW	MENCK
1.0	1122	4.40	3.27	2.20	8.80
3.0	16,360	64.20	28.57	17.15	68.70
7.0	39,805	156.19	46.07	26.35	105.40
15.0	392,203	1539.00	163.48	95.49	381.76

<sup>a</sup>Three models were used to calculate excess lung cancer based on epidemiological data.

-Stocks<sup>23</sup> measured pollution and cancer mortality for 26 communities in Britain. These data were used to develop a regression equation of the form  $C = a + xB + YA + 2BA$  where C is the male lung cancer mortality per 100,000; a is the base lung cancer rate; B is the benzo(a)pyrene exposure in ng/m<sup>3</sup>, A is the arsenic exposure in ng/m<sup>3</sup>; and x,y,z are constant from the regression analysis.

-Carnow and Meier<sup>16</sup> used regression models of lung cancer and BaP data on a state by state basis.

-Menck, et al<sup>13</sup> studied lung cancer data by tract.  
Carnow and Meier.

Benzo(a)Pyrene and Arsenic levels were estimated from ambient data from the Illinois EPA<sup>21,22</sup> and the USEPA<sup>24</sup>

Population data are from USEPA<sup>24</sup>

TABLE V

PREDICTED EXCESS LUNG CANCERS DUE TO EXPOSURE TO BENZO(A)PYRENE AND ARSENIC FROM COKE PLANT AT INTERLAKE STEEL, CHICAGO

DISTANCE FROM COKE OVEN (Km)	MALE POPULATION WITHIN GIVEN DISTANCE	EXPECTED LUNG CANCERS (10 YRS) WITHIN GIVEN DISTANCE	EXCESS LUNG CANCERS (10 yrs) WITHIN GIVEN DISTANCE PREDICTED BY GIVEN MODEL <sup>a</sup>		
			STOCKS	CARNOW	MENCK
0.5	414	1.62	1.16	0.65	2.59.
1.0	4068	15.96	8.02	3.88	15.50
3.0	33,190	130.24	41.48	15.30	61.21
7.0	157,314	617.30	137.14	44.53	178.11
15.0	733,843	2879.60	372.85	101.19	404.74

<sup>a</sup>Three models were used to calculate excess lung cancers based on epidemiological data.

- Stocks<sup>23</sup> measured pollution and cancer mortality for 26 communities in Britain. These data were used to develop a regression equation of the form  $C = a + xB + yA + zBA$  where C is the male lung cancer mortality per 100,000; a is the base lung cancer rate; B is the benzo(a)pyrene exposure in ng/m<sup>3</sup>; A is the arsenic exposure in mg/m<sup>3</sup>; and x,y,z are constants from the regression analysis.
- Carnow and Meier<sup>16</sup> used regression models of lung cancer and BaP data on a state by state basis
- Menck, et al<sup>13</sup> studied lung cancer data by tract.

Benzo(a)Pyrene and Arsenic levels were estimated from ambient data from the Illinois EPA<sup>22</sup> and the USEPA<sup>24</sup>

Population data are from USEPA<sup>24</sup>

TABLE VI: NUMBER OF EXCESS CANCERS FOR GIVEN POPULATIONS AND RATES OF EXCESS

CANCER SITE	SEX	POPULATION IN THOUSANDS	ILLINOIS RATE	10 YR EXP CANCER #	SD	EXCESS # OF CANCERS (*= OUT. 95% LIMIT)			
						10%	30%	50%	100%
1 Lung(162,163)	M	25	39.24	49.1	7.01	4.9	14.7*	24.6*	49.1*
2		100		196.2	14.01	19.6	58.9*	98.1*	196.2*
3		200		392.4	19.81	39.2*	117.7*	196.2*	390.4*
4	F	25	6.52	8.2	2.86	0.8	2.5	4.1	8.2*
5		100		32.6	5.71	3.3	9.8	16.3*	32.6*
6		200		65.2	8.07	6.5	19.6*	32.6*	65.2*
7 Bladder(181)	M	25	7.53	9.4	3.07	0.9	2.8	4.7	9.4*
8		100		37.7	6.14	3.8	11.3	18.9*	37.7*
9		200		75.3	8.68	7.5	22.6*	37.7*	75.3*
10	F	25	2.50	3.1	1.76	0.3	0.9	1.6	3.1
11.		100		12.5	3.54	1.3	3.8	6.3	12.5*
12		200		25.0	5.00	2.5	7.5	12.5*	25.0*
13 Esophagus(150)	M	25	5.20	6.6	2.57	0.7	2.0	3.3	6.6*
14		100		26.3	5.13	2.6	7.9	13.2*	26.3*
15		200		52.6	7.25	5.3	15.8*	26.3*	52.6*
16	F	25	.98	1.2	1.10	0.1	0.4	0.6	1.2
17		100		4.9	2.21	0.5	1.5	2.5	4.9*
18		200		9.8	3.13	1.0	2.9	4.9	9.8*
19 Stomach(151)	M	25	16.72	20.9	4.57	2.1	6.3	10.5*	20.9*
20		100		83.6	9.14	8.4	25.1*	41.8*	83.6*
21		200		167.2	12.93	16.7	50.2*	83.6*	167.2*
22	F	25	8.48	10.6	3.26	1.1	3.2	5.3	10.6*
23		100		42.4	6.51	4.2	12.7	21.2*	42.4*
24		200		84.8	9.21	8.5	25.4	42.4*	84.8*

a Source: Reference 2 ; Rates are per 100,000 population per year

## 2. Mortality Rates in Study Areas

Names of all persons dying from certain cancer types between 1969 and 1977 in Madison and St. Clair counties were obtained from Illinois State death tapes.<sup>24</sup> Death certificates for these persons were obtained and a computer data base was constructed including for each decedent: age, tract of residence at death (within study areas), race, sex, and type of cancer. Additionally, population data were collected for all tracts in the study area, and stored on computer data base.

Age adjusted cancer mortality rates were computed for each study tract from these data. Mortality rates were computed for race, and sex category, and for all categories combined. Additionally the Mantel-Haenszel test for combined data from four fold tables were performed to check the significance of the difference in the mortality notes. The results of these computations are presented in Tables VII to XVI.

CANCER MORTALITY DATA TABLE ANNOTATION

These tables contain age adjusted cancer mortality rates for high, medium, and low exposure tracts for the study areas in Madison, and St. Clair counties. These rates are age adjusted to the 1970 U.S. population. These data should be considered preliminary for the following reasons:

1. mechanical checks on the computation methods are still being performed;
2. updates on the population are being made to take into account population shifts which occurred after 1970;
3. tract boundaries are being redrawn using computations of ambient pollutant levels made with dispersion models.

The significance levels for a chi square test with one degree of freedom are as follows:

p = .05; chi square = 3.84

p = .01; chi square = 6.63

TABLE VII

GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

TOTAL

	HIGH EXPOSURE LEVEL						LOW EXPOSURE LEVEL						HIGH:LOW		
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	HAENSZEL	MANTEL					
DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE	DEATH RATE	# OF DEATHS	RATIO	RISK	CHI SQ.							
NASOPHARYNX	0.0	0.0	0	0.61	0.58	1	0.0	0.0							0.426
TONGUE, MOUTH, THROAT	0.33	0.37	2	3.67	3.22	6	0.116	0.116							7.510
ESOPHAGUS	2.14	2.40	13	0.61	0.52	1	4.555	4.657							1.590
STOMACH	3.13	3.70	19	0.61	0.52	1	7.124	7.182							3.850
LIVER	0.0	0.0	0	2.45	2.06	4	0.0	0.0							6.888
PANCREAS	4.94	5.53	30	9.17	8.29	15	0.673	0.667							1.180
RESPIRATORY	33.42	37.75	203	33.64	29.90	55	1.262	1.262							2.126
BREAST	7.74	8.80	47	15.29	13.50	25	0.651	0.652							2.552
UTERUS	3.95	4.30	24	5.50	4.95	9	0.861	0.869							0.030
PROSTATE	5.10	6.22	31	10.40	9.01	17	0.695	0.690							1.132
KIDNEY	2.47	2.82	15	2.45	2.12	4	1.319	1.326							0.051
BLADDER	3.46	4.11	21	3.67	3.16	6	1.302	1.303							0.125
MELANOMA	0.33	0.37	2	0.0	0.0	0	$\infty$	$\infty$							0.000
BRAIN	2.96	3.24	18	3.06	2.95	5	1.123	1.099							0.000
ALL ABOVE NEOPLASMS	69.98	79.62	425	91.13	80.77	149	0.986	0.986							0.009

<sup>a</sup>Death rate is per 100,000 population per year

TABLE VIII GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

TOTAL MALE

	HIGH EXPOSURE TRACT						LOW EXPOSURE TRACT						HIGH:LOW		
	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	ODDS RATIO	RELATIVE RISK				MANTEL HAENSZEL CHI SQ.			
NASOPHARYNX	0.0	0.0	0	1.27	1.19	1	0.0	0.0				0.449			
TONGUE, MOUTH, THROAT	0.68	0.75	2	6.36	5.82	5	0.129	0.129				5.971			
ESOPHAGUS	3.04	3.33	9	1.27	1.15	1	2.918	2.907				0.455			
STOMACH	4.05	4.79	12	1.27	1.15	1	4.188	4.175				1.373			
LIVER	0.0	0.0	0	1.27	1.15	1	0.0	0.0				0.287			
PANCREAS	6.08	6.68	18	11.45	10.68	9	0.627	0.625				0.875			
RESPIRATORY	55.71	62.03	165	59.81	54.84	47	1.131	1.131				0.441			
BREAST	0.0	0.0	0	0.0	0.0	0	...	...				...			
UTERUS	0.0	0.0	0	0.0	0.0	0	...	...				...			
PROSTATE	10.47	12.53	31	21.63	19.68	17	0.634	0.637				1.863			
KIDNEY	3.04	3.34	9	1.27	1.15	1	2.939	2.910				0.469			
BLADDER	5.74	6.70	17	5.09	4.63	4	1.445	1.447				0.173			
MELANOMA	0.34	0.34	1	0.0	0.0	0	∞	∞				0.449			
BRAIN	4.05	4.42	12	3.82	3.67	3	1.214	1.204				0.000			
ALL ABOVE NEOPLASMS	93.18	104.92	276	114.52	105.10	90	0.998	0.998				0.002			

<sup>a</sup>Death rate is per 100,000 population per year

TABLE IX

GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW EXPOSURE TRACTS

TOTAL FEMALE

	HIGH EXPOSURE TRACT						LOW EXPOSURE TRACT						HIGH:LOW		
	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQ.	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQ.	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQ.
NASOPHARYNX	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...	...	...	...
TONGUE, MOUTH, THROAT	0.0	0.0	0	1.18	0.95	1	0.0	0.0	0.19	0.0	0.0	0.0	0.0	0.0	0.40
ESOPHAGUS	1.29	1.48	4	0.0	0.0	0	...	...	...	...	...	...	...	...	...
STOMACH	2.25	2.63	7	0.0	0.0	0	...	...	...	...	...	...	...	...	1.40
LIVER	0.0	0.0	0	3.53	2.86	3	...	...	...	...	...	...	...	...	4.12
PANCREAS	3.86	4.38	12	7.07	6.02	6	0.720	0.728	0.14	0.720	0.728	0.14	0.720	0.728	0.14
RESPIRATORY	12.21	13.73	38	9.42	8.47	8	1.628	1.621	1.20	1.628	1.621	1.20	1.628	1.621	1.20
BREAST	15.11	17.43	47	29.44	25.43	25	0.684	0.686	1.94	0.684	0.686	1.94	0.684	0.686	1.94
UTERUS	7.71	8.50	24	10.60	9.38	9	0.894	0.906	0.00	0.894	0.906	0.00	0.894	0.906	0.00
PROSTATE	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...	...	...	...
KIDNEY	1.93	2.29	6	3.53	3.03	3	0.761	0.756	0.00	0.761	0.756	0.00	0.761	0.756	0.00
BLADDER	1.29	1.55	4	2.36	1.90	2	0.800	0.813	0.03	0.800	0.813	0.03	0.800	0.813	0.03
MELANOMA	0.32	0.40	1	0.0	0.0	0	...	...	...	...	...	...	...	...	...
BRAIN	1.93	2.07	6	2.36	2.24	2	0.925	0.920	0.10	0.925	0.920	0.10	0.925	0.920	0.10

aDeath rate is per 100,000 population per year

TABLE X GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

WHITEHIGH EXPOSURE TRACTLOW EXPOSURE TRACTHIGH:LOW

	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQUARE
NASOPHARYNX	0.0	0.0	0	0.64	0.62	1	0.0	0.0	0.40
TONGUE, MOUTH, THROAT	0.36	0.42	0.42	3.21	2.86	5	0.145	0.146	4.80
ESOPHAGUS	1.95	2.25	11	0.0	0.0	0	$\infty$	$\infty$	2.57
STOMACH	2.84	3.46	16	0.64	0.56	1	6.156	6.187	2.95
LIVER	0.0	0.0	0	2.57	2.24	4	0.0	0.0	6.59
PANCREAS	5.15	5.92	29	9.62	8.91	15	0.669	0.665	1.21
RESPIRATORY	33.39	39.07	188	33.35	30.58	52	1.279	1.278	2.25
BREAST	7.99	9.34	45	15.39	13.90	24	0.670	0.672	2.06
UTERUS	3.91	4.34	22	5.77	5.33	9	0.812	0.815	0.09
PROSTATE	4.80	6.12	27	10.90	9.75	17	0.630	0.628	1.83
KIDNEY	2.66	3.14	15	2.57	2.30	4	1.364	1.368	0.08
BLADDER	3.73	4.61	21	3.85	3.42	6	1.349	1.350	0.18
MELANOMA	0.36	0.42	2	0.0	0.0	0	$\infty$	$\infty$	0.00
BRAIN	2.66	2.98	15	3.21	3.15	5	0.959	0.947	0.03

<sup>a</sup>Death rate is per 100,000 population per year

TABLE XI

GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

BLACK

	HIGH EXPOSURE TRACT						LOW EXPOSURE TRACT						HIGH: LOW		
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	MANTEL				HAENSZEL	CHI SQ.	
	DEATH RATE	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	RATIO	RISK								
NASOPHARYNX	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TONGUE, MOUTH, THROAT	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ESOPHAGUS	4.75	4.23	2	14.23	10.09	1	0.382	0.419	0.419	0.0	0.0	0.0	0.0	0.0	
STOMACH	7.12	6.04	3	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
LIVER	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PANCREAS	2.37	2.01	1	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
RESPIRATORY	33.24	31.00	14	42.68	30.28	3	0.881	1.024	1.024	0.0	0.0	0.0	0.0	0.01	
BREAST	4.75	4.03	2	14.23	14.60	1	0.401	0.276	0.276	0.0	0.0	0.0	0.0	0.0	
UTERUS	4.75	5.02	2	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.09	
PROSTATE	9.50	8.26	4	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.04	
KIDNEY	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BLADDER	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
MELANOMA	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
BRAIN	7.12	6.44	3	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

<sup>a</sup>Death rate is per 100,000 population per year

TABLE XII SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	TOTAL										HIGH: MED+LOW		
	HIGH EXPOSURE TRACT					MED+LOW EXP TRACT					ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQUARE
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	ODDS RATIO			
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	ODDS RATIO			
	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATHS	DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>			
NASOPHARYNX	0.26	0.27	3	0.11	0.10	1				2.483	2.620	0.087	
TONGUE, MOUTH, THROAT	2.04	2.24	24	2.96	2.81	26				0.811	0.797	0.356	
ESOPHAGUS	2.30	2.59	27	2.85	2.73	25				0.956	0.950	0.001	
STOMACH	5.27	5.96	62	5.36	5.13	47				1.169	1.162	0.506	
LIVER	0.94	1.05	11	0.68	0.65	6				1.624	1.609	0.520	
PANCREAS	6.55	7.33	77	7.75	7.41	68				1.701	0.989	0.006	
RESPIRATORY	29.18	32.40	343	41.02	38.74	360				0.838	0.836	5.280	
BREAST	9.53	10.57	112	18.46	17.55	162				0.607	0.602	16.233	
UTERUS	7.23	8.10	85	5.70	5.45	50				1.496	1.484	4.777	
PROSTATE	8.00	9.21	94	9.69	9.37	85				0.986	0.983	0.000	
KIDNEY	1.36	1.50	16	3.65	3.50	32				0.436	0.429	6.898	
BLADDER	3.23	3.70	38	4.67	4.51	41				0.824	0.820	0.555	
MELANOMA	0.51	0.58	6	1.94	1.87	17				0.306	0.312	6.022	
LEUKEMIA	1.96	2.21	23	2.28	2.18	20				1.003	1.014	0.020	
BRAIN	1.70	1.89	20	3.30	3.17	29				0.589	0.596	2.952	

<sup>a</sup>Death rate is per 100,000 population per year

TABLE XIII SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	HIGH EXPOSURE TRACT						MED+LOW EXP TRACT						HIGH : MED+LOW		
	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	ODDS RATIO	RELATIVE RISK				MANTEL, HAENSZEL CHI SQUARE			
TOTAL			MALE												
NASOPHARYNX	0.0	0.0	0	0.24	0.21	1	0.0	0.0				0.00			
TONGUE, MOUTH, THROAT	3.61	3.94	20	4.53	4.38	19	0.913	0.900				0.01			
ESOPHAGUS	3.79	4.15	21	4.05	3.98	17	1.049	1.043				0.00			
STOMACH	5.59	6.16	31	6.44	6.39	27	0.968	0.964				0.00			
LIVER	1.26	1.37	7	0.72	0.71	3	1.989	1.935				0.49			
PANCREAS	8.30	8.98	46	8.82	8.59	37	1.062	1.045				0.02			
RESPIRATORY	49.06	53.41	272	66.05	63.66	277	0.845	0.839				3.73			
PROSTATE	16.95	18.72	94	20.27	20.69	85	0.911	0.905				0.30			
KIDNEY	2.34	2.58	13	4.77	4.69	20	0.551	0.549				2.32			
BLADDER	3.07	3.38	17	7.15	7.25	30	0.468	0.467				5.84			
MELANOMA	0.54	0.61	3	2.15	2.13	9	0.285	0.284				3.04			
BRAIN	1.98	2.16	11	5.01	4.87	21	0.436	0.444				4.60			

<sup>a</sup>Death rate is per 100,000 population per year

TABLE XIV SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

TOTAL FEMALE

	HIGH EXPOSURE TRACT						MED+LOW EXP TRACT						HIGH: MED+LOW		
	CRUDE	AGE-ADJ.	TOTAL # OF DEATHS	CRUDE	AGE-ADJ.	TOTAL	ODDS RATIO	RELATIVE RISK		MANTEL	HAENSZEL	CHI SQUARE			
	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATHS	RATIO								
NASOPHARYNX	0.48	0.52	3	0.0	0.0	0	0.0	0.0					0.92		
TONGUE, MOUTH, THROAT	0.64	0.71	4	1.53	1.43	7	0.512	0.498					0.59		
ESOPHAGUS	0.97	1.13	6	1.75	1.64	8	0.698	0.690					0.15		
STOMACH	4.99	5.80	31	4.36	4.09	20	1.426	1.416					1.20		
LIVER	0.64	0.76	4	0.65	0.61	3	1.232	1.240					0.01		
PANCREAS	4.99	5.85	31	6.77	6.35	31	0.929	0.921					0.02		
RESPIRATORY	11.43	12.87	71	18.11	17.05	83	0.753	0.755					2.81		
BREAST	18.03	20.22	112	35.14	33.05	161	0.617	0.612					15.04		
UTERUS	13.52	15.33	84	10.91	10.27	50	1.504	1.492					4.82		
KIDNEY	0.48	0.54	3	2.62	2.47	12	0.226	0.219					4.95		
BLADDER	3.38	3.95	21	2.40	2.25	11	1.767	1.755					1.86		
MELANOMA	0.48	0.59	3	1.75	1.69	8	0.335	0.349					2.14		
LEUKEMIA	1.45	1.62	9	1.96	1.86	9	0.887	0.872					0.00		
BRAIN	1.45	1.67	9	1.75	1.64	8	1.016	1.021					0.04		

<sup>a</sup>Death rate is per 100,000 population per year

TABLE XV SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	WHITE										HIGH: MED+LOW			
	HIGH EXPOSURE TRACT				MED+LOW EXP TRACT				TOTAL		ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQUARE	
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATHS	RATIO	RISK			
NASOPHARYNX	0.32	0.34	2	0.11	0.11	0.11	0.11	1	1	2.912	3.189	0.112		
TONGUE, MOUTH, THROAT	1.94	1.90	12	2.98	2.93	2.93	2.93	26	0.669	0.649	0.981			
ESOPHAGUS	2.10	2.13	13	2.86	2.85	2.85	2.85	25	0.758	0.746	0.417			
STOMACH	5.49	5.60	34	5.39	5.36	5.36	5.36	47	1.056	1.046	0.017			
LIVER	0.81	0.82	5	0.69	0.68	0.68	0.68	6	1.214	1.207	0.000			
PANCREAS	5.98	6.04	37	7.79	7.74	7.74	7.74	68	0.792	0.780	1.087			
RESPIRATORY	31.84	31.97	197	41.14	40.19	40.19	40.19	359	0.797	0.795	6.337			
BREAST	10.34	10.42	64	18.45	18.17	18.17	18.17	161	0.579	0.574	13.524			
UTERUS	7.11	7.34	44	5.73	5.69	5.69	5.69	50	1.288	1.290	1.258			
PROSTATE	4.85	5.07	30	9.74	9.82	9.82	9.82	85	0.517	0.517	9.409			
KIDNEY	1.78	1.80	11	3.67	3.65	3.65	3.65	32	0.501	0.494	3.444			
BLADDER	4.20	4.34	26	4.70	4.72	4.72	4.72	41	0.928	0.919	0.031			
MELANOMA	0.97	1.01	6	1.95	1.92	1.92	1.92	17	0.518	0.526	1.442			
LEUKEMIA	2.10	2.21	13	2.29	2.27	2.27	2.27	20	0.950	0.976	0.001			
BRAIN	2.75	2.79	17	3.32	3.26	3.26	3.26	29	0.847	0.857	0.157			

<sup>a</sup>Death rate is per 100,000 population per year

TABLE XVI

SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	BLACK										HIGH : MED+LOW				
	HIGH EXPOSURE TRACT			MED+LOW EXP TRACT			MED+LOW EXP TRACT				MANTEL		HAENSZEL		
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	# OF	ODDS	RELATIVE	RISK	CHI SQUARE				
	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATHS	DEATHS	RATIO	RISK	CHI SQUARE					
NASOPHARYNX	0.18	0.18	1	0.0	0.0	0	0	∞	∞	45.499					
TONGUE, MOUTH, THROAT	2.17	2.25	12	0.0	0.0	0	0	∞	∞	2.510					
ESOPHAGUS	2.53	2.55	14	0.0	0.0	0	0	∞	∞	1.977					
STOMACH	5.05	5.05	28	0.0	0.0	0	0	∞	∞	0.606					
LIVER	1.08	1.09	6	0.0	0.0	0	0	∞	∞	5.715					
PANCREAS	7.22	7.24	40	0.0	0.0	0	0	∞	∞	0.249					
RESPIRATORY	26.35	26.78	146	32.87	29.05	1	0.915	0.922	0.922	0.190					
BREAST	8.66	9.01	48	32.87	29.05	1	0.294	0.310	0.310	0.137					
UTERUS	7.40	7.61	41	0.0	0.0	0	∞	∞	∞	0.245					
PROSTATE	11.55	11.48	64	0.0	0.0	0	∞	∞	∞	0.025					
KIDNEY	0.90	0.93	5	0.0	0.0	0	0	∞	∞	7.247					
BLADDER	2.17	2.15	12	0.0	0.0	0	0	∞	∞	2.425					
MELANOMA	0.0	0.0	0	0.0	0.0	0	0.0	∞	∞	•••					
BRAIN	0.54	0.54	3	0.0	0.0	0	0	∞	∞	13.017					

<sup>a</sup>Death rates are per 100,000 population per year

The results for the Granite City area tend to support the hypothesis that increased exposure to carcinogens leads to higher cancer mortality rates. The relative risk (for the high exposure tract to the low exposure tract) was greater than 1 for the cancers most likely to be associated with exposure to PAH (esophagus, stomach, respiratory) for all categories of persons (with the exception being cancer of the esophagus for blacks where only three deaths were recorded). The size of the relative risk varied from slightly over 1 to over 7. The Mantel-Haenszel chi square test was significant in several cases.

For all types in the study combined, the cancer rate was very slightly higher in the low exposure tract. Our initial hypothesis is that an outmigration from the high exposure tract produced apparently higher rates for cancers not strongly associated with exposure to air pollution, while for those with a strong air pollution effect, the excess cancer mortality overwhelmed the outmigration effect. Further study is needed of census data, as well as possible followup interviews to investigate this hypothesis. Also the tracts should be remapped using pollution levels based on dispersion model calculations or ground level monitoring.

In the Sauget area relative risks were computed for the high tract versus the medium and low tracts. With a few exceptions, the relative risks were less than one even for cancers associated with exposures to air pollutants. Possible explanations for these results include outmigrations from the high exposure tract, and poor correlation between tracts and actual exposure levels. Further study is required in the area as in the first study area.

B. Factors in Cancer Mortality Study

1. Correlations of Mortality Rates With Industrial Concentration

Pearson correlation tests on the association between cancer mortality rate (1950-1969) and industry concentration (as measured by percent of workforce employed in the industry) were run for all Illinois counties for several cancer types and industry types. The results are presented in Table XVII.

Significant positive correlations were found only with metal industry concentration. Most of the cancer mortality rates considered showed significant correlations with the metal industry. The highest correlations, .408, was found with male bladder cancer.

2. Correlation of Mortality Rates with Selected Etiological Factors

For selected counties and groups of counties, Pearson correlation tests were performed on the associations between certain site specific cancer mortality rates and a number of demographic, climatic, pollutant, and industrial factors previously suspected or shown to be associated with cancer mortality. This calculation has been performed with mortality data from the period 1950 to 1969, and will be updated when the later mortality data are tabulated. The results are presented in Table XVIII.

Factors that showed significantly high correlations with a number of cancer mortality rates included: urbanization, median income, mean level of TSP, sulfur oxides, and value added in the chemical, metal, and petroleum industries. Cancer types which generally showed the highest correlations included: lung, bladder, esophagus, stomach, and female breast.

Generally a cancer type showing high correlations with one category of variables (e.g., demographic) showed high correlations with other categories of variable (e.g., pollutant variables, and industrialization variables).

TABLE XVII CORRELATIONS OF INDUSTRIALIZATION WITH CERTAIN CANCER TYPE FOR ALL ILLINOIS COUNTIES<sup>a</sup>

INDUSTRY TYPE	FEMALE LUNG	MALE LUNG	FEMALE ALL	MALE ALL	FEMALE BLADDER	MALE BLADDER	FEMALE LIVER AND GALLBLADDER	MALE LIVER AND GALLBLADDER
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CHEMICAL	-0.0292	-0.0273	-0.0141	-0.0172	0.0054	0.0896	-0.1861	-0.1571
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PETROLEUM	0.0451	0.0904	-0.1179	0.0171	-0.0195	-0.1614	-0.0384	0.0877
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METAL	0.3034 **	0.2046 *	0.2037 *	0.2841 *	0.1739 *	0.4079 **	0.2040 *	0.1099
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<sup>a</sup> Industrialization is based on percent of workers in a county employed by a given industry type. Cancer rates are from reference 2. Industrial data is from reference 25.

\* Indicates  $P < .05$

\*\* Indicates  $P < .01$

TABLE XVIII CORRELATION OF VARIOUS CANCER AND MALFORMATION RATES WITH A NUMBER OF ETIOLOGICAL FACTORS<sup>a</sup> (By County in Illinois)

Cancer/Malformation Type/ Etiological Factor	CORRELATION TESTS											
	ALL		LUNG		BLADDER		LIVER		PANCREAS		BREAST	
	M	F	M	F	M	F	M	F	M	F	M	F
Urbanization (%)	0.761**	0.479*	0.768***	0.753**	0.612**	0.490***	-0.368*	-0.665**	0.359*	-0.182	0.190	0.801*
Population Density (persons/sq.mi.)	0.617**	0.344	0.463*	0.612*	0.432*	0.274	0.200	-0.075	0.361*	0.031	0.049	0.533**
Non-white (%)	0.607*	0.285	0.704***	0.536**	0.293	0.321	-0.014	-0.252	0.260	-0.080	-0.023	0.324
Mean Income (Dollars)	0.512**	0.272	0.462*	0.630**	0.793**	0.318	-0.418*	-0.629**	0.176	-0.221	-0.094	0.834**
Sunshine (Mean Annual Hours)	-0.217	-0.032	-0.057	-0.181	-0.695**	-0.306	0.510**	0.460*	-0.175	0.161	-0.152	-0.625*
Solar Radiation (Mean Daily Langley's)	-0.196	-0.021	-0.033	-0.168	-0.699**	-0.375*	0.506**	-0.041	-0.041	0.278	-0.225	-0.675*
Total Suspended Particulates (ug/m <sup>3</sup> )	0.597**	0.414*	0.568***	0.355	0.632**	0.310	-0.360*	-0.428*	0.174	-0.253	0.392*	0.563**
SO <sub>2</sub> (ug/m <sup>3</sup> )	0.647**	0.659**	0.770**	0.548**	0.317	0.317	-0.192	-0.409*	0.264	-0.108	0.081	0.418*
Chemical Industry (# Employed)	-0.287	-0.205	-0.283	-0.076	-0.106	-0.011	-0.073	-0.035	-0.218	-0.106	-0.385	-0.170
Petroleum Industry (# Employed)	-0.233	-0.044	-0.184	-0.173	-0.369*	-0.200	0.134	0.171	0.465*	0.931**	-0.242	-0.275
Metal Industry (# Employed)	-0.011	0.480*	0.049	0.059	0.190	0.155	-0.120	-0.036	0.002	-0.060	-0.183	-0.172
Valve-Added (\$1,000's)												
Chemical Industry	0.548**	0.271	0.411*	0.502**	0.379*	0.292	0.198	0.034	0.317	0.032	0.019	0.441*
Petroleum Industry	0.490***	0.672**	0.458*	0.447*	0.330	0.233	0.234	0.069	0.262	0.028	0.019	0.232
Metal Industry	0.572**	0.498**	0.462*	0.501**	0.378*	0.288	0.228	0.028	0.326	0.025	0.078	0.351
Valve-Added/Sq.Mi.												
Chemical Industry	0.551*	0.252	0.434*	0.559**	0.455*	0.305	0.128	-0.117	0.307	0.008	-0.069	0.508*
Petroleum Industry	0.469*	0.725**	0.467*	0.445*	0.353	0.229	0.199	0.046	0.212	-0.030	-0.031	0.216
Metal Industry	0.594**	0.557**	0.498*	0.544*	0.431*	0.302	0.197	-0.011	0.333	0.008	0.063	0.377*
Chemical Industry	-0.134	-0.246	-0.002	0.061	0.269	0.033	-0.185	-0.401	-0.142	-0.212	-0.296	0.173
Petroleum Industry	0.044	0.649**	0.210	0.107	0.097	0.007	0.058	0.042	0.058	0.092	-0.148	-0.141
Metal Industry	0.196	0.698**	0.337	0.210	0.375*	0.173	-0.153	-0.130	0.051	-0.138	-0.054	0.015

TABLE XVIII (Cont.d)

CORRELATION OF VARIOUS CANCER AND MALFORMATION RATES WITH A NUMBER OF ETIOLOGICAL FACTORS<sup>a</sup>

(By County in Illinois)

Cancer Mortality Type/ Etiological Factor	CORRELATION TESTS												MAMMARY GLAND		
	UTERUS		PROSTATE		STOMACH		ESOPHAGUS		KIDNEY		SALIVARY GLAND				
	F	M	M	F	M	F	M	F	M	F	M	F	M	F	M
Urbanization (%)	0.326	-0.021	0.482*	0.133	0.615**	0.202	0.533*	0.165	0.011	-0.014	0.312	.408*			
Population Density (persons/sq.mi.)	0.204	0.112	0.603**	0.482	0.617**	0.534**	0.254	0.196	0.149	0.069	0.220	0.086			
Non-White (%)	0.376	-0.223	0.329	0.255	0.615**	0.316	0.262	0.279	-0.060	-0.148	0.148	-0.166			
Mean Income (Dollars)	0.250	0.073	0.541**	0.181	0.483*	0.214	0.575**	-0.005	0.080	0.019	0.238	0.332			
Sunshine (Mean Annual Hours)	-0.047	0.016	-0.490**	-0.223	-0.332	-0.099	-0.682**	-0.115	-0.211	-0.181	-0.057	0.146			
Solar Radiation (Mean Daily Langleys)	0.044	0.038	-0.045*	-0.181	-0.325	-0.032	-0.626**	-0.119	-0.182	-0.246	-0.128	0.134			
Total Suspended Parti- culate (ug/m <sup>3</sup> )	0.138	-0.074	0.350	-0.001	0.628**	0.142	0.413*	0.138	-0.077	0.044	-0.014	0.101			
SO <sub>2</sub> (ug/m <sup>3</sup> )	0.298	0.049	0.123	-0.084	0.577**	0.339	0.297	0.185	-0.015	-0.332	0.321	0.412*			
Chemical Industry (% Employed)	0.247	0.039	-0.135	0.062	-0.055	0.171	-0.078	-0.008	0.252	-0.299	-0.075	-0.204			
Petroleum Industry (% Employed)	-0.351	0.122	-0.031	-0.000	-0.409*	0.021	-0.196	0.061	-0.222	-0.090	-0.440*	-0.054			
Metal Industry (% Employed)	0.243	-0.104	-0.292	-0.193	-0.023	0.296	0.071	0.010	0.325	-0.212	-0.155	0.171			
Valve-Added (\$1,000's) Chemical Industry	0.127	0.034	0.615**	0.500***	0.620***	0.547*	0.208	0.226	0.109	0.035	0.160	-0.108			
Petroleum Industry	0.125	-0.112	0.358	0.279	0.506**	0.585**	0.154	0.134	0.030	0.016	0.062	0.076			
Metal Industry	0.197	-0.018	0.474*	0.406*	0.581**	0.580**	0.218	0.209	0.149	0.063	0.162	0.027			
Valve-Added/Sq.Mi.															
Chemical Industry	0.065	0.042	0.649***	0.460*	0.629**	0.542**	0.215	0.184	0.066	-0.037	0.120	-0.093			
Petroleum Industry	0.115	-0.148	0.307	0.209	0.490**	0.572**	0.150	0.096	0.008	-0.011	0.043	0.112			
Metal Industry	0.202	-0.034	0.464*	0.368*	0.584**	0.586**	0.242	0.198	0.153	0.056	0.158	0.090			
Valve-Added/Person															
Chemical Industry	-0.095	-0.429*	0.204	-0.002	0.174	0.210	0.151	0.183	-0.140	-0.116	-0.103	-0.387*			
Petroleum Industry	-0.063	-0.277	-0.124	-0.190	0.018	0.283	-0.011	-0.048	-0.180	-0.108	-0.206	0.173			
Metal Industry	0.185	-0.319	-0.160	-0.234	0.116	0.268	0.252	-0.039	0.054	-0.083	-0.061	0.224			

TABLE XVIII -  
(con. 't)

CORRELATION OF VARIOUS CANCER AND MALFORMATION RATES WITH A NUMBER OF ETIOLOGICAL FACTORS<sup>a</sup> (By County in Illinois)

Cancer Malformation Type/ Etiological Factor	NOSE		LIP		TONGUE		LEUKEMIA		SKIN		TOTAL MALFORMATIONS	
	M	F	M	F	M	F	M	F	M	F	.1974	.1975
Urbanization (%)	-0.043	0.173	-0.137	-0.167*	0.553*	0.289	-0.171	-0.366*	-0.056	-0.179	-0.306	-0.320
Population Density (persons/sq.mi.)	-0.081	0.105	-0.178	-0.159	0.472*	0.208	-0.082	-0.055	-0.094	-0.062	-0.300	-0.342
Non-white (%)	-0.176	0.006	-0.244	0.757*	0.298	-0.221	-0.245	-0.076	-0.148	-0.014	-0.205	-0.232
Mean Income (Dollars)	-0.068	0.005	-0.286	-0.413*	0.141	0.105	-0.272	-0.218	-0.085	-0.014	-0.125	-0.155
Sunshine (Mean Annual Hours)	-0.004	-0.060	0.327	0.356	0.139	-0.164	0.248	0.117	0.179	-0.044	0.121	-0.080
Solar Radiation (Mean Daily Langleys)	-0.115	-0.098	0.291	0.367*	0.145	-0.161	0.246	0.166	0.287	0.070	0.223	0.123
Total Suspended Parti- culate (ug/m <sup>3</sup> )	-0.119	0.111	-0.202	-0.264	0.471*	-0.115	-0.340	-0.276	-0.049	-0.057	-0.284	-0.300
SO <sub>2</sub> (ug/m <sup>3</sup> )	-0.157	0.206	0.128	-0.315	0.703**	0.032	-0.048	-0.215	0.079	-0.214	-0.086	-0.242
Chemical Industry (% Employed)	0.137	0.007	0.385*	-0.176	-0.143	-0.170	-0.061	0.263	-0.298	-0.112	0.466*	0.070
Petroleum Industry (% Employed)	-0.426*	-0.061	0.321	-0.105	-0.173	0.320	0.162	0.155	0.388*	0.078	0.095	0.055
Metal Industry (% Employed)	0.236	-0.227	0.141	-0.141	0.063	-0.180	0.009	0.070	0.024	0.004	0.298	0.101
Valve-Added (\$1,000's)												
Chemical Industry	-0.113	0.114	-0.131	-0.140	0.483*	0.221	-0.130	-0.010	-0.120	-0.095	-0.223	-0.255
Petroleum Industry	-0.092	-0.101	-0.206	-0.147	0.445*	0.132	-0.038	-0.083	0.117	-0.167	-0.071	-0.093
Metal Industry	-0.012	0.034	-0.156	-0.142	0.500**	0.187	-0.069	-0.071	-0.024	-0.109	-0.222	-0.245
Valve-Added/Sq.Mi.												
Chemical Industry	-0.179	0.081	-0.164	-0.165	0.467*	0.194	-0.167	-0.005	-0.119	-0.080	-0.171	-0.196
Petroleum Industry	-0.089	-0.150	-0.239	-0.151	0.426*	0.084	-0.046	-0.099	0.138	-0.180	-0.019	-0.034
Metal Industry	-0.002	0.010	-0.190	-0.166	0.516**	0.175	-0.083	-0.097	-0.013	-0.109	-0.223	-0.235
Valve-Added/Person												
Chemical Industry	-0.179	-0.034	-0.106	-0.264	0.061	0.053	-0.626**	-0.080	-0.402*	-0.362*	0.148	0.196
Petroleum Industry	-0.161	-0.328	-0.144	-0.140	0.090	-0.018	-0.018	-0.104	0.314	-0.188	0.231	0.237
Metal Industry	0.145	-0.308	-0.156	-0.238	0.185	-0.052	-0.120	-0.256	0.171	-0.123	0.124	0.127

NOTE: \*This chart is based on correlations using 15 industrial counties in Illinois and seven groups of non-identical counties. M indicates rates for males, F for females; both are rates for whites; one asterisk (\*) indicates the correlation is significant at p<0.05; two asterisks (\*\*) indicate significance at p<0.01. Mortality data from reference 2. Industrial data from reference 33.

TABLE XVIII (con.'t)

A. INDUSTRIAL COUNTIES (TREATED INDIVIDUALLY)

Cook  
Kane  
Lake  
DuPage  
Will  
St. Clair  
Madison  
Peoria  
Tazewell  
Kankakee  
LaSalle  
Rock Island  
Vermillion  
Whiteside  
Henry

B. RURAL COUNTIES

<u>Group 1</u>	<u>Group 7</u>
Calhoun	Macoupin
Jersey	Bond
Greene	Clinton
Macoupin	Monroe
Pike	
Scott	
<u>Group 2</u>	
Schuylerv	
Mason	
Hancock	
Brown	
Fulton	
<u>Group 3</u>	
Gallatin	
Hamilton	
White	
Lawrence	
Wayne	
Edwards	
Richland	
<u>Group 4</u>	
Franklin	
Jefferson	
Clay	
Jasper	
<u>Group 5</u>	
Clinton	
Bond	
Fayette	
Shelby	
Moultrie	
Cumberland	
<u>Group 6</u>	
DeWitt	
Piatt	
Douglas	
Edgar	
Shelby	
Moultrie	

This fact suggests that some of the correlations may be spurious, and that further analyses should be performed to try to separate the real from the spurious correlations.

C. Congenital Malformation Study

1. Relation of Malformation Rates to Carcinogenic Exposure

In preliminary studies, we have examined two heavily industrialized areas in southern Illinois for rates of all congenital malformations. A wide range of major sources of industrial carcinogens have been located in these areas, and adjacent high and low exposure tracts were mapped based on Illinois Environmental Protection Agency ground level monitoring data on total suspended particulates (TSP) and arsenic. Rates of congenital malformations in these areas were computed using birth tapes and certificates. Preliminary analysis, using the Mantel-Haenszel chi-square test, indicates that in one of the study areas (Granite City), statistically significant increased incidences of congenital malformations were found in the high compared to the low exposure tract. For nine of ten malformations categories, the malformation rates were higher in the higher exposure tract, and the difference in rates for total malformations was significant at the P=.05 level. In the other study area (Sauget City), preliminary analysis revealed no consistent difference between the high and low exposure tracts. The results are presented in Tables XIX and XX.

2. Correlation Analyses

Pearson correlations were performed between congenital malformation rates (for 1974 and 1975 separately), and a number of possible etiological factors on county basis for Illinois. The same industrial counties and

TABLE XIX Saugat City Birth Defects For 1968-1977, High and Medium + Low Exposure Tracts

Defect Category	High Exposure Level			Low Exposure Level			High: Low		
	Crude Defect Rate	Total # Of Defects	Crude Defect Rate	Total # of Defects	Odds Ratio	Relative Risk	Mantel Haenszel Chi Sq.	Chi. sq.	Significant Level
Monstrosity	12.15	3	44.50	5	0.397	0.273	1.236	.70	
Spina Bifida	48.61	12	35.60	4	1.560	0.366	0.312	.40	
Hydrocephalus	24.31	6	71.19	8	0.358	0.341	2.701	.80	
Nervous System	105.32	26	71.19	8	1.422	1.479	0.428	.40	
Circulatory System	76.97	19	106.79	12	0.720	0.721	0.512	.50	
Larellip	48.61	12	133.49	15	0.371	0.364	5.302	.95	
Digestive System	157.98	39	97.89	11	1.589	1.614	1.572	.70	
Genito-Urinary System	117.48	29	329.27	37	0.383	0.357	13.876	.99	
Kidney	623.84	154	427.16	48	1.514	1.460	5.667	.95	
Other	174.19	43	329.27	37	0.548	0.529	6.700	.99	
Total	1389.45	343	1646.35	185	0.873	0.844	1.994	.80	

TABLE XX Granite City Birth Defects For 1968-1977, High and Medium and Low Exposure Tracts

Defect Category	High Exposure Level			Low Exposure Level			High : Low		
	Crude Defect Rate	Total # of Defects	Crude Defect Rate	Total # of Defects	Odds Ratio	relative risk	Mantel Haenszel Chi sq.	Chi sq; significan- t level	
Monstrosity	71.28	7	79.46	2	0.839	0.897	0.046	.10	
Spina Bifida	112.00	11	39.73	1	2.614	2.819	0.369	.40	
Hydrocephalus	40.73	4	0.0	0	0.0	0.0	0.032	.10	
Nervous System	234.19	23	39.73	1	5.974	5.895	3.072	.90	
Circulatory System	193.46	19	39.73	1	4.104	4.869	1.695	.80	
Harelip	203.65	20	119.19	3	1.584	1.709	0.195	.30	
Digestive System	213.83	21	79.46	2	2.438	2.691	0.996	.60	
Genito-Urinary System	437.84	43	397.30	10	1.139	1.102	0.034	.10	
Bone	498.93	49	278.11	7	1.686	1.794	1.180	.70	
Other	509.11	50	158.92	4	3.502	3.042	5.495	.95	
Total	2515.02	247	1231.62	31	2.039	2.042	13.256	.99	

sets of rural counties were used as in the similar analyses on cancer mortality rates. The only high, significant correlation was with density of chemical industry as measured by fraction of the workforce employed in the industry. The results of the analyses appear in Table XVIII.

Additionally, Pearson correlation analyses were performed between congenital malformation rates (for 1974 and 1975 separately) and cancer mortality rates (for the period 1950-1969) for a number of cancer types. The correlations were performed on a county basis using data from all 102 counties in Illinois. The results are presented in Table XXI. Significant correlations were found only with male lung cancer, and female pancreatic cancer.

#### D. Cancer Map Update

We have computed age adjusted cancer mortality rates for all Illinois counties for the period 1970-1977. Selected rates for selected counties are presented in Table XXII along with rates for the period 1950 to 1969 as a comparision. The new rates are age adjusted to the U.S. population for the 1970, while the 1950 to 1969 rates are age adjusted to the 1960 U.S. population. Table XXIII lists the highest five counties in Illinois for cancer of a number of sites.

TABLE XXI-CORRELATION OF VARIOUS CANCERS WITH CONGENITAL MALFORMATION RATES FOR ILLINOIS (BY COUNTY), 1974 and 1975<sup>a</sup>

<u>ALL</u>		<u>ESOPHAGUS</u>		<u>PROSTATE</u>		<u>NERVOUS SYSTEM</u>		<u>LEUKEMIA</u>		<u>KIDNEY</u>		<u>LIP</u>	
M	F	M	F	M	F	M	F	M	F	M	F	M	F
1974	0.0263	-0.0821	0.0748	0.0849	0.1160			-0.2811	-0.0792	-0.0053	-0.2676	-0.0902	0.0153
1975	0.0477	0.0636	0.0792	0.880	-0.0191			0.0172	0.1240	-0.0574	-0.0286	-0.0914	-0.1149
<u>SALIVARY GLAND</u>													
1974	0.0890	0.0781	-0.1013	0.0091	0.0194			-0.0809	0.1819**	0.0013	0.0357	-0.0585	
1975	0.0383	0.0398	-0.0529	0.0027	-0.0729			-0.1253	0.0811	0.1029	0.0602	0.0169	
<u>LIVER</u>													
1974	0.0385	-0.0994	-0.1798	-0.1710									
1975	-0.0404	-0.0645	0.0356	0.2039*									
<u>PANCREAS</u>													

<sup>a</sup> Cancer mortality rates from Reference 2; congenital malformation data from Reference 24.\* Indicates that  $p < .05$ \*\* Indicates that  $p < .01$

TABLE XXII- AGE ADJUSTED CANCER DEATH RATES FOR SELECTED COUNTIES IN ILLINOIS, ADJUSTED TO 1970 U.S. POPULATION. (white pop. only)

COUNTY	RESPIRATORY	STOMACH	BREAST	BLADDER	MELANOMA
COOK					
male:	61.09	11.31	-	7.80	1.64
female:	17.69	7.65	35.75	2.81	1.19
GRUNDY					
male:	44.82	0.0	-	0.0	0.0
female:	23.40	0.0	39.33	0.0	0.0
LAKE					
male:	61.20	8.87	-	9.11	2.10
female:	18.57	5.09	37.87	1.71	1.17
ST.CLAIR					
male:	70.47	6.05	-	7.08	0.0
female:	18.03	5.52	32.66	1.85	0.0
WILL					
male:	61.53	8.41	-	4.49	0.0
female:	12.09	5.31	36.44	4.15	0.0
STATE TOTAL					
male:	61.11	8.31	-	6.24	1.00
female:	15.13	5.20	32.20	2.12	0.65

TABLE XXIII AGE-ADJUSTED CANCER DEATH RATES (PER 100,000 PER YEAR) FOR TOP  
FIVE COUNTIES, BY RANK 1970-77 (WHITE POP. ONLY)

STOMACH

<u>MALE:</u>	STATE TOTAL	8.31	<u>FEMALE:</u>	STATE TOTAL	5.20
1. Moultrie	14.88		1. Kendall	9.03	
2. Shelby	12.49		2. Jefferson	9.88	
3. Cumberland	12.21		3. Rock Is.	8.61	
4. Cook	11.31		4. Cass	8.46	
5. LaSalle	11.01		5. Cook	7.65	

RESPIRATORY

<u>MALE:</u>	STATE TOTAL	61.11	<u>FEMALE:</u>	STATE TOTAL	15.31
1. Alexander	100.44		1. Fayette	26.47	
2. Pulaski	85.03		2. Christian	21.74	
3. Marion	84.73		3. Coles	20.05	
4. Williamson	81.12		4. DuPage	19.05	
5. Ford	80.82		5. Lake	18.57	

BREAST

<u>FEMALE:</u>	STATE TOTAL	33.20
1. Ogle	53.08	
2. Boone	84.86	
3. Shelby	43.66	
4. Warren	81.66	
5. Monroe	80.22	

BLADDER

<u>MALE:</u>	STATE TOTAL	6.24	<u>FEMALE:</u>	STATE TOTAL	2.12
1. Gallatin	18.01		1. Iroquois	9.23	
2. Kane	10.48		2. Ford	9.16	
3. Marshall	10.35		3. Logan	4.77	
4. Lake	9.11		4. Will	4.15	
5. McHenry	9.08		5. Saline	3.86	

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CANCER MORTALITY DATA TABLE ANNOTATION

(Supplement to Geographic Distribution of Cancer in Illinois report)

These tables contain age adjusted cancer mortality rates for high, medium, and low exposure tracts for the study areas in Madison, and St. Clair counties. The rates are age adjusted to the 1970 U.S. Population. These data should be considered preliminary for the following reasons:

1. mechanical checks on the computation methods are still being performed;
2. updates on the populations are being made to take into account population shifts which occurred after 1970; 3. tract boundaries are being redrawn using computations of ambient pollutant levels made with dispersion models.

## GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW AREAS

## TOTAL FEMALE

	HIGH EXPOSURE TRACT						LOW EXPOSURE TRACT						HIGH : LOW		
	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQ.	...	...	...	...	...	...
NASOPHARYNX	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...	...	...	...
TONGUE, MOUTH, THROAT	0.0	0.0	0	1.18	0.95	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.19
ESOPHAGUS	1.29	1.48	4	0.0	0.0	0	...	...	...	...	...	...	...	...	0.40
STOMACH	2.25	2.63	7	0.0	0.0	0	...	...	...	...	...	...	...	...	1.40
LIVER	0.0	0.0	0	3.53	2.86	3	...	...	...	...	...	...	...	...	4.12
PANCREAS	3.86	4.38	12	7.07	6.02	6	0.720	0.728	0.728	0.728	0.728	0.728	0.728	0.728	0.14
RESPIRATORY	12.21	13.73	38	9.42	8.47	8	1.628	1.621	1.621	1.621	1.621	1.621	1.621	1.621	1.20
BREAST	15.11	17.43	47	29.44	25.43	25	0.684	0.686	0.686	0.686	0.686	0.686	0.686	0.686	1.94
UTERUS	7.71	8.50	24	10.60	9.38	9	0.894	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.00
PROSTATE	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...	...	...	...
KIDNEY	1.93	2.29	6	3.53	3.03	3	0.761	0.756	0.756	0.756	0.756	0.756	0.756	0.756	0.00
BLADDER	1.29	1.55	4	2.36	1.90	2	0.800	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.03
MELANOMA	0.32	0.40	1	0.0	0.0	0	...	...	...	...	...	...	...	...	...
BRAIN	1.93	2.07	6	2.36	2.24	2	0.925	0.920	0.920	0.920	0.920	0.920	0.920	0.920	0.10

<sup>a</sup>Death rate is per 100,000 population per year

## GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

TOTAL

	HIGH EXPOSURE LEVEL				LOW EXPOSURE LEVEL				HIGH:LOW		
	CRUDE	AGE-ADJ.	TOTAL # OF DEATHS	CRUDE	AGE-ADJ	TOTAL # OF DEATHS	CRUDE	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL, CHI SQ.	
NASOPHARYNX	0.0	0.0	0	0.61	0.58	1	0.0	0.0	0.0	0.426	
TONGUE, MOUTH, THROAT	0.33	0.37	2	3.67	3.22	6	0.116	0.116	7.510		
ESOPHAGUS	2.14	2.40	13	0.61	0.52	1	4.555	4.657	1.590		
STOMACH	3.13	3.70	19	0.61	0.52	1	7.124	7.182	3.850		
LIVER	0.0	0.0	0	2.45	2.06	4	0.0	0.0	6.888		
PANCREAS	4.94	5.53	30	9.17	8.29	15	0.673	0.667	1.180		
RESPIRATORY	33.42	37.75	203	33.64	29.90	55	1.262	1.262	2.126		
BREAST	7.74	8.80	47	15.29	13.50	25	0.651	0.652	2.552		
UTERUS	3.95	4.30	24	5.50	4.95	9	0.861	0.869	0.030		
PROSTATE	5.10	6.22	31	10.40	9.01	17	0.695	0.690	1.132		
KIDNEY	2.47	2.82	15	2.45	2.12	4	1.319	1.326	0.051		
BLADDER	3.46	4.11	21	3.67	3.16	6	1.302	1.303	0.125		
MELANOMA	0.33	0.37	2	0.0	0.0	0	$\infty$	$\infty$	0.000		
BRAIN	2.96	3.24	18	3.06	2.95	5	1.123	1.099	0.000		
ALL ABOVE NEOPLASMS	69.98	79.62	425	91.13	80.77	149	0.986	0.986	0.009		

<sup>a</sup>Death rate is per 100,000 population per year

## GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

## TOTAL MALE

	HIGH EXPOSURE TRACT						LOW EXPOSURE TRACT						HIGH:LOW		
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	RISK	MANTEL	HAENSZEL	CHI SQ.			
	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	RATIO	RATIO	RISK							
NASOPHARYNX	0.0	0.0	0	1.27	1.19	1	0.0	0.0	0.0				0.449		
TONGUE, MOUTH, THROAT	0.68	0.75	2	6.36	5.82	5	0.129	0.129	0.129				5.971		
ESOPHAGUS	3.04	3.33	9	1.27	1.15	1	2.918	2.907	2.907				0.455		
STOMACH	4.05	4.79	12	1.27	1.15	1	4.188	4.175	4.175				1.373		
LIVER	0.0	0.0	0	1.27	1.15	1	0.0	0.0	0.0				0.287		
PANCREAS	6.08	6.68	18	11.45	10.68	9	0.627	0.627	0.627				0.875		
RESPIRATORY	55.71	62.03	165	59.81	54.84	47	1.131	1.131	1.131				0.441		
BREAST	0.0	0.0	0	0.0	0.0	0	...	...	...				...		
UTERUS	0.0	0.0	0	0.0	0.0	0	...	...	...				...		
PROSTATE	10.47	12.53	31	21.63	19.68	17	0.634	0.637	0.637				1.863		
KIDNEY	3.04	3.34	9	1.27	1.15	1	2.939	2.910	2.910				0.469		
BLADDER	5.74	6.70	17	5.09	4.63	4	1.445	1.447	1.447				0.173		
MELANOMA	0.34	0.34	1	0.0	0.0	0	∞	∞	∞				0.449		
BRAIN	4.05	4.42	12	3.82	3.67	3	1.214	1.204	1.204				0.000		
ALL ABOVE NEOPLASMS	93.18	104.92	276	114.52	105.10	90	0.998	0.998	0.998				0.002		

<sup>a</sup>Death rate is per 100,000 population per year

## GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW TRACTS

## WHITE

	HIGH EXPOSURE TRACT			LOW EXPOSURE TRACT			HIGH:LOW		
	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL DEATHS	CRUDE DEATH RATE <sup>a</sup>	AGE-ADJ. DEATH RATE <sup>a</sup>	TOTAL # OF DEATHS	ODDS RATIO	RELATIVE RISK	MANTEL HAENSZEL CHI SQUARE
ASOPHARYNX	0.0	0.0	0	0.64	0.62	1	0.0	0.0	0.40
ONGUE, MOUTH, THROAT	0.36	0.42	3.21	2.86	5	0.145	0.146	4.80	
SOPHAGUS	1.95	2.25	11	0.0	0.0	0	$\infty$	$\infty$	2.57
TOMACH	2.84	3.46	16	0.64	0.56	1	6.156	6.187	2.95
LIVER	0.0	0.0	0	2.57	2.24	4	0.0	0.0	6.59
ANCREAS	5.15	5.92	29	9.62	8.91	15	0.669	0.665	1.21
RESPIRATORY	33.39	39.07	188	33.35	30.58	52	1.279	1.278	2.25
BREAST	7.99	9.34	45	15.39	13.90	24	0.670	0.672	2.06
UTERUS	3.91	4.34	22	5.77	5.33	9	0.812	0.815	0.09
PROSTATE	4.80	6.12	27	10.90	9.75	17	0.630	0.628	1.83
KIDNEY	2.66	3.14	15	2.57	2.30	4	1.364	1.368	0.08
BLADDER	3.73	4.61	21	3.85	3.42	6	1.349	1.350	0.18
MELANOMA	0.36	0.42	2	0.0	0.0	0	$\infty$	$\infty$	0.00
BRAIN	2.66	2.98	15	3.21	3.15	5	0.959	0.947	0.03

<sup>a</sup>Death rate is per 100,000 population per year

## GRANITE CITY CANCER DEATHS FOR 1969-1977, HIGH AND LOW AREAS

BLACK

	HIGH EXPOSURE TRACT				LOW EXPOSURE TRACT				HIGH: LOW			
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	RISK	MANTEL	HAENSZEL	CHI SQ.
	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	RATIO	RISK	RISK	RISK			
NASOPHARYNX	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
TONGUE, MOUTH, THROAT	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...
ESOPHAGUS	4.75	4.23	2	14.23	10.09	1	0.382	0.419	0.419	0.00	0.00	0.00
STOMACH	7.12	6.04	3	0.0	0.0	0	...	...	...	...	...	0.00
LIVER	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	0.0
PANCREAS	2.37	2.01	1	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.80
RESPIRATORY	33.24	31.00	14	42.68	30.28	3	0.881	1.024	1.024	0.01	0.01	0.01
BREAST	4.75	4.03	2	14.23	14.60	1	0.401	0.276	0.276	0.00	0.00	0.00
UTERUS	4.75	5.02	2	0.0	0.0	0	...	...	...	0.09	0.09	0.09
PROSTATE	9.50	8.26	4	0.0	0.0	0	...	...	...	0.04	0.04	0.04
KIDNEY	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...
BLADDER	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...
MELANOMA	0.0	0.0	0	0.0	0.0	0	...	...	...	...	...	...
BRAIN	7.12	6.44	3	0.0	0.0	0	...	...	...	0.00	0.00	0.00

<sup>a</sup>Death rate is per 100,000 population per year

## SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	TOTAL						HIGH: MED+LOW					
	HIGH EXPOSURE TRACT			MED+LOW EXP TRACT			TOTAL			RELATIVE RISK		
CRUDE	AGE-ADJ;	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS RATIO	DEATH RATE <sup>a</sup>	# OF DEATHS	ODDS RATIO	DEATH RATE <sup>a</sup>	MANTEL HAENSZEL CHI SQUARE	
DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATHS							
NASOPHARYNX	0.26	0.27	3	0.11	0.10	1		2.483	2.620	0.087		
TONGUE, MOUTH, THROAT	2.04	2.24	24	2.96	2.81	26		0.811	0.797	0.356		
ESOPHAGUS	2.30	2.59	27	2.85	2.73	25		0.956	0.950	0.001		
STOMACH	5.27	5.96	62	5.36	5.13	47		1.169	1.162	0.506		
LIVER	0.94	1.05	11	0.68	0.65	6		1.624	1.609	0.520		
PANCREAS	6.55	7.33	77	7.75	7.41	68		1.701	0.989	0.006		
RESPIRATORY	29.18	32.40	343	41.02	38.74	360		0.838	0.836	5.280		
BREAST	9.53	10.57	112	18.46	17.55	162		0.507	0.602	16.233		
UTERUS	7.23	8.10	85	5.70	5.45	50		1.496	1.484	4.777		
PROSTATE	8.00	9.21	94	9.69	9.37	85		0.986	0.983	0.000		
KIDNEY	1.36	1.50	16	3.65	3.50	32		0.436	0.429	6.898		
BLADDER	3.23	3.70	38	4.67	4.51	41		0.824	0.820	0.555		
MELANOMA	0.51	0.58	6	1.94	1.87	17		0.306	0.312	6.022		
LEUKEMIA	1.96	2.21	23	2.28	2.18	20		1.003	1.014	0.020		
BRAIN	1.70	1.89	20	3.30	3.17	29		0.589	0.596	2.952		

<sup>a</sup>Death rate is per 100,000 population per year

## SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	HIGH EXPOSURE TRACT		MED+LOW EXP TRACT		TOTAL		MALE		HIGH : MED+LOW	
	CRUDE	AGE-ADJ.	CRUDE	AGE-ADJ.	TOTAL	# OF	ODDS	RELATIVE	MANTEL	HAENSZEL
	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATHS	RATIO	RISK		CHI SQUARE	
NASOPHARYNX	0.0	0.0	0	0.24	0.21	1	0.0	0.0	0.00	
TONGUE, MOUTH, THROAT	3.61	3.94	20	4.53	4.38	19	0.913	0.900	0.01	
ESOPHAGUS	3.79	4.15	21	4.05	3.98	17	1.049	1.043	0.00	
STOMACH	5.59	6.16	31	6.44	6.39	27	0.968	0.964	0.00	
LIVER	1.26	1.37	7	0.72	0.71	3	1.989	1.935	0.49	
PANCREAS	8.30	8.98	46	8.82	8.59	37	1.062	1.045	0.02	
RESPIRATORY	49.06	53.41	272	66.05	63.66	277	0.845	0.839	3.73	
PROSTATE	16.95	18.72	94	20.27	20.69	85	0.911	0.905	0.30	
KIDNEY	2.34	2.58	13	4.77	4.69	20	0.551	0.549	2.32	
BLADDER	3.07	3.38	17	7.15	7.25	30	0.468	0.467	5.84	
MELANOMA	0.54	0.61	3	2.15	2.13	9	0.285	0.284	3.04	
BRAIN	1.98	2.16	11	5.01	4.87	21	0.436	0.444	4.60	

<sup>a</sup>Death rate is per 100,000 population per year

## SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	HIGH EXPOSURE TRACT		MED+LOW EXP TRACT		TOTAL		FEMALE		HIGH: MED+LOW	
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	MANTTEL	HAENSZEL
	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	RATIO	RISK	CHI SQUARE		
NASOPHARYNX	0.48	0.52	3	0.0	0.0	0	0.0	0.0	0.92	
TONGUE, MOUTH, THROAT	0.64	0.71	4	1.53	1.43	7	0.512	0.498	0.59	
ESOPHAGUS	0.97	1.13	6	1.75	1.64	8	0.698	0.690	0.15	
STOMACH	4.99	5.80	31	4.36	4.09	20	1.426	1.416	1.20	
LIVER	0.64	0.76	4	0.65	0.61	3	1.232	1.240	0.01	
PANCREAS	4.99	5.85	31	6.77	6.35	31	0.929	0.921	0.02	
RESPIRATORY	11.43	12.87	71	18.11	17.05	83	0.753	0.755	2.81	
BREAST	18.03	20.22	112	35.14	33.05	161	0.617	0.612	15.04	
UTERUS	13.52	15.33	84	10.91	10.27	50	1.504	1.492	4.82	
KIDNEY	0.48	0.54	3	2.62	2.47	12	0.226	0.219	4.95	
BLADDER	3.38	3.95	21	2.40	2.25	11	1.767	1.755	1.86	
MELANOMA	0.48	0.59	3	1.75	1.69	8	0.335	0.349	2.14	
LEUKEMIA	1.45	1.62	9	1.96	1.86	9	0.887	0.872	0.00	
BRAIN	1.45	1.67	9	1.75	1.64	8	1.016	1.021	0.04	

<sup>a</sup>Death rate is per 100,000 population per year

## SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	HIGH EXPOSURE TRACT				MED+LOW EXP TRACT				HIGH: MED+LOW			
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	RISK	MANTEL	HAENSZEL	CHI SQUARE
	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	DEATHS	RATIO						
NASOPHARYNX	0.32	0.34	2	0.11	0.11	1	2.912	3.189	0.112			
TONGUE, MOUTH, THROAT	1.94	1.90	12	2.98	2.93	26	0.669	0.649	0.981			
ESOPHAGUS	2.10	2.13	13	2.86	2.85	25	0.758	0.746	0.417			
STOMACH	5.49	5.60	34	5.39	5.36	47	1.056	1.046	0.017			
LIVER	0.81	0.82	5	0.69	0.68	6	1.214	1.207	0.000			
PANCREAS	5.98	6.04	37	7.79	7.74	68	0.792	0.780	1.087			
RESPIRATORY	31.84	31.97	197	41.14	40.19	359	0.797	0.795	6.337			
BREAST	10.34	10.42	64	18.45	18.17	161	0.579	0.574	13.524			
UTERUS	7.11	7.34	44	5.73	5.69	50	1.288	1.290	1.258			
PROSTATE	4.85	5.07	30	9.74	9.82	85	0.517	0.517	9.409			
KIDNEY	1.78	1.80	11	3.67	3.65	32	0.501	0.494	3.444			
BLADDER	4.20	4.34	26	4.70	4.72	41	0.928	0.919	0.031			
MELANOMA	0.97	1.01	6	1.95	1.92	17	0.518	0.526	1.442			
LEUKEMIA	2.10	2.21	13	2.29	2.27	20	0.950	0.976	0.001			
BRAIN	2.75	2.79	17	3.32	3.26	29	0.847	0.857	0.157			

<sup>a</sup>Death rate is per 100,000 population per year

## SAUGET CANCER DEATHS FOR 1969-1977, HIGH AND MED+LOW TRACTS

	HIGH EXPOSURE TRACT						MED+LOW EXP TRACT						BLACK		
	CRUDE	AGE-ADJ.	TOTAL	CRUDE	AGE-ADJ.	TOTAL	ODDS	RELATIVE	RISK	MANTEL	HAENSZEL	CHI SQUARE	HIGH : MED+LOW		
	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	DEATH RATE <sup>a</sup>	DEATH RATE <sup>a</sup>	# OF DEATHS	RATIO								
NASOPHARYNX	0.18	0.18	1	0.0	0.0	0	$\infty$	$\infty$	$\infty$				45.499		
TONGUE, MOUTH, THROAT	2.17	2.25	12	0.0	0.0	0	$\infty$	$\infty$	$\infty$				2.510		
ESOPHAGUS	2.53	2.55	14	0.0	0.0	0	$\infty$	$\infty$	$\infty$				1.977		
STOMACH	5.05	5.05	28	0.0	0.0	0	$\infty$	$\infty$	$\infty$				0.606		
LIVER	1.08	1.09	6	0.0	0.0	0	$\infty$	$\infty$	$\infty$				5.715		
PANCREAS	7.22	7.24	40	0.0	0.0	0	$\infty$	$\infty$	$\infty$				0.249		
RESPIRATORY	26.35	26.78	146	32.87	29.05	1	0.915	0.922	0.922				0.190		
BREAST	3.66	9.01	48	32.87	29.05	1	0.294	0.310	0.310				0.137		
UTERUS	7.40	7.61	41	0.0	0.0	0	$\infty$	$\infty$	$\infty$				0.245		
PROSTATE	11.55	11.48	64	0.0	0.0	0	$\infty$	$\infty$	$\infty$				0.025		
KIDNEY	0.90	0.93	5	0.0	0.0	0	$\infty$	$\infty$	$\infty$				7.247		
BLADDER	2.17	2.15	12	0.0	0.0	0	$\infty$	$\infty$	$\infty$				2.425		
MELANOMA	0.0	0.0	0	0.0	0.0	0	$\infty$	$\infty$	$\infty$				...		
BRAIN	0.54	0.54	3	0.0	0.0	0	$\infty$	$\infty$	$\infty$				13.017		

aDeath rates are per 100,000 population per year







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